Claims

1. A fuel cell comprising:

at least one hydrogen electrode pair in contact with a hydrogen stream;

at least one oxygen electrode pair in contact with an oxygen stream;

at least one electrolyte chamber, wherein said electrolyte chamber provides mechanical support within said fuel cell and provides an uninterrupted pathway for an electrolyte solution to contact said hydrogen electrode pair and said oxygen electrode pair; and

at least one compression plate.

2. The fuel cell according to claim 1, wherein said electrolyte chamber comprises a porous support structure disposed between a pair of membranes.

3. The fuel cell according to claim 2, wherein said porous support structure is comprised of an expanded polymer sheet.

4. The fuel cell according to claim 3, wherein said expanded polymer sheet is comprised of a polyolefin.

5. The fuel cell according to claim 4, wherein said electrolyte chamber contacts an electrolyte contacting surface of said hydrogen electrode pair and said oxygen electrode pair.

6. The fuel cell according to claim 5, wherein said membrane prevents excess electrolyte solution from contacting said hydrogen electrode pair and said oxygen electrode pair.

7. The fuel cell according to claim 6, wherein said membrane prevents said oxygen stream and said hydrogen stream from penetrating into said electrolyte.

8. The fuel cell according to claim 1, wherein said hydrogen electrode pair comprises an anode active material having hydrogen storage capacity.

9. The fuel cell according to claim 8, wherein said hydrogen electrode pair comprises a hydrogen inlet and a hydrogen outlet.

10. The fuel cell according to claim 9, wherein said hydrogen electrode pair comprises a first hydrogen electrode and a second hydrogen electrode.

11. The fuel cell according to claim 10, wherein said first and second hydrogen electrode have a hydrogen contacting surface, an electrolyte solution contacting surface, and a bulk of said active anode material.

12. The fuel cell according to claim 11, wherein said bulk of said anode active material is disposed between said hydrogen contacting surface and said electrolyte contacting surface.

13. The fuel cell according to claim 12, wherein said hydrogen contacting surface is adapted to dissociate and adsorb gaseous hydrogen.

14. The fuel cell according to claim 13, wherein said bulk of said anode active material is adapted to store said adsorbed hydrogen.

15. The fuel cell according to claim 14, wherein said electrolyte contacting surface is adapted to react said stored hydrogen with an electrolyte solution.

16. The fuel cell according to claim 15, wherein said first and second hydrogen electrodes have a plurality of channels depressed into said hydrogen contacting surface.

17. The fuel cell according to claim 16, wherein said channels extend vertically and horizontally across said hydrogen contacting surface.

18. The fuel cell according to claim 17, wherein said hydrogen contacting surfaces of said first and second hydrogen electrodes are adjacently disposed and said plurality of channels line up to form a series of hydrogen flow channels between said first and second hydrogen electrodes.

19. The fuel cell according to claim 18, wherein said hydrogen electrodes have a deep channel on said hydrogen contacting surface extending vertically along each edge of said first and second hydrogen electrodes.

20. The fuel cell according to claim 19, wherein said deep channels form a manifold when said hydrogen contacting surfaces of said first and second hydrogen electrodes are adjacently disposed.

21. The fuel cell according to claim 20, wherein said deep channels have a conductive backing.

22. The fuel cell according to claim 21, wherein said conductive backing is nickel.

23. The fuel cell according to claim 21, wherein said conductive backing is adapted to collect an electrical current.

24. The fuel cell according to claim 23, wherein said conductive backing is electrically connected to said anode active material.

25. The fuel cell according to claim 20, wherein said manifold distributes hydrogen to said plurality of channels.

26. The fuel cell according to claim 15, wherein a porous sheet is disposed between said first and second hydrogen electrodes, wherein said sheet is adapted to allow a stream of hydrogen to flow across said hydrogen electrodes while maintaining mechanical support within said fuel cell.

27. The fuel cell according to claim 10, wherein said first and second hydrogen electrode comprise an anode active material layer, a porous polytetrafluoroethylene layer, and a current collector grid.

28. The fuel cell according to claim 27, wherein said anode active material layer is disposed between said current collector grid and said polytetrafluoroethylene layer.

29. The fuel cell according to claim 28, wherein said anode active material layer is dispersed throughout said current collector grid.

30. The fuel cell according to claim 27, wherein said anode active material layer comprises a mixture of mischmetal nickel alloy, raney nickel, graphite, and polytetrafluoroethylene powder.

31. The fuel cell according to claim 30, wherein said anode active material layer has the following composition:

35 weight percent mischmetal nickel alloy,

46 weight percent raney nickel,

4 weight percent graphite, and

15 weight percent polytetrafluoroethylene powder.

32. The fuel cell according to claim 27, wherein said current collector grid comprises at least one selected from the group consisting of mesh, grid, matte, expanded metal, foil, foam and plate.

33. The fuel cell according to claim 32, wherein said current collector grid is comprised of a conductive metal.

34. The fuel cell according to claim 33, wherein said conductive metal is nickel.

35. The fuel cell according to claim 1, wherein said oxygen electrode pair comprises a cathode active material.

36. The fuel cell according to claim 35, wherein said oxygen electrode pair comprises an oxygen inlet and an oxygen outlet.

37. The fuel cell according to claim 36, wherein said oxygen electrode pair comprises a first oxygen electrode and a second oxygen electrode.

38. The fuel cell according to claim 37, wherein said first and second oxygen electrode have an oxygen contacting surface, an electrolyte solution contacting surface, and a bulk of said cathode active material.

39. The fuel cell according to claim 38, wherein said bulk of said cathode active material is disposed between said oxygen contacting surface and said electrolyte contacting surface.

40. The fuel cell according to claim 39, wherein said oxygen contacting surface is adapted to dissociate and adsorb gaseous oxygen.

41. The fuel cell according to claim 40, wherein said bulk of said cathode active material is adapted to store said adsorbed oxygen.

42. The fuel cell according to claim 41, wherein said electrolyte contacting surface is adapted to react said stored oxygen with an electrolyte solution.

43. The fuel cell according to claim 42, wherein said first and second oxygen electrodes have a plurality of channels having a wave configuration depressed into said oxygen contacting surface.

44. The fuel cell according to claim 43, wherein said channels extend horizontally across said oxygen contacting surface.

45. The fuel cell according to claim 44, wherein said oxygen contacting surfaces of said first and second oxygen electrodes are adjacently disposed and said plurality of channels line up to form a series of oxygen flow channels between said first and second oxygen electrodes.

46. The fuel cell according to claim 45, wherein said oxygen electrodes have a deep channel on said oxygen contacting surface extending vertically along each edge of said first and second oxygen electrodes.

47. The fuel cell according to claim 46, wherein said deep channels form a manifold when said oxygen contacting surfaces of said first and second oxygen electrodes are adjacently disposed.

48. The fuel cell according to claim 47, wherein said deep channels have a conductive backing.

49. The fuel cell according to claim 48, wherein said conductive backing is nickel.

50. The fuel cell according to claim 48, wherein said conductive backing is adapted to collect an electrical current.

51. The fuel cell according to claim 50, wherein said conductive backing is electrically connected to said cathode active material.

52. The fuel cell according to claim 47, wherein said manifold distributes oxygen to said series of channels.

53. The fuel cell according to claim 42, wherein a porous sheet is disposed between said first and second hydrogen electrodes, wherein said sheet is adapted to allow a stream of hydrogen to flow across said hydrogen electrodes while maintaining mechanical support within said fuel cell.

54. The fuel cell according to claim 37, wherein said first and second oxygen electrodes comprise a gas diffusion layer, a catalyst layer, a polytetrafluoroethylene layer, and a current collector grid.

55. The fuel cell according to claim 54, wherein said catalyst layer is disposed between said gas diffusion layer and said current collector grid.

56. The fuel cell according to claim 55, wherein said gas diffusion layer is disposed between said catalyst layer and said polytetrafluoroethylene layer.

57. The fuel cell according to claim 56, wherein said polytetrafluoroethylene layer is in intimate contact with said oxygen stream.

58. The fuel cell according to claim 57, wherein said catalyst layer is dispersed throughout said current collector grid.

59. The fuel cell according to claim 58, wherein said current collector grid is in intimate contact with said electrolyte stream.

60. The fuel cell according to claim 59, wherein said current collector comprises at least one selected from the group consisting of mesh, grid, matte, expanded metal, foil, foam and plate.

61. The fuel cell according to claim 60, wherein said current collector grid is comprised of nickel.

62. The fuel cell according to claim 61, wherein said gas diffusion layer has the following composition:

40 weight percent polytetrafluoroethylene;

60 weight percent carbon black.

63. The fuel cell according to claim 62, wherein said catalyst layer has the following composition:

50 weight percent of a mixture by weight of 40 percent polytetrafluoroethylene and 60 percent carbon black,

15 weight percent carbon black;

15 weight percent graphite;

20 weight percent silver oxide.

64. The fuel cell according to claim 63, wherein said silver oxide contains a lithium aluminum alloy.

65. The fuel cell according to claim 64, wherein said silver oxide contains gallium.

66. The fuel cell according to claim 1, wherein said compression plate is adapted to absorb expansion of said hydrogen electrode pair and said oxygen electrode pair.

67. The fuel cell according to claim 66, wherein said compression plate provides mechanical support within said fuel cell.

68. The fuel cell according to claim 67, wherein said compression plate is comprised of rubber.

69. The fuel cell according to claim 1, wherein said electrolyte solution is comprised of a potassium hydroxide solution.

70. The fuel cell according to claim 1, wherein said oxygen stream comprises air.

71. The fuel cell according to claim 1, wherein said hydrogen stream comprises gaseous hydrogen.

72. The fuel cell according to claim 1, wherein said fuel cell is adapted to operate at ambient pressures.

73. The fuel cell according to claim 1, wherein said hydrogen electrode pair is disposed between said electrolyte chambers.

74. The fuel cell according to claim 73, wherein said hydrogen electrode pair and said electrolyte chambers are disposed between said oxygen electrode pairs.

75. The fuel cell according to claim 74, wherein said hydrogen electrode pair, said electrolyte chambers, and said oxygen electrode pairs are disposed between said electrolyte chambers.

76. The fuel cell according to claim 75, wherein said hydrogen electrode pair, said electrolyte chambers, and said oxygen electrode pairs are disposed between said compression plates.

77. The fuel cell according to claim 76, wherein said hydrogen electrode pair, said electrolyte chambers, said oxygen

electrode pairs, and said compression plates are disposed between a pair of electrode end plates.

78. The fuel cell according to claim 77, wherein said hydrogen electrode pair, said electrolyte chambers, said oxygen electrode pairs, said compression plates, and said electrode end plates are disposed between a pair of fuel cell end plates.

79. The fuel cell according to claim 78, wherein said fuel cell end plates are bolted together to provide mechanical support and compression within said fuel cell.